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BASELINE ENVIRONMENTAL SURVEY
MC CONE COUNTY, MONTANA

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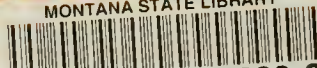
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BASELINE ENVIRONMENTAL SURVEY

MC CONE COUNTY, MONTANA

Proposal No. 448

July 9, 1976

Submitted to:

Montana Department of Natural
Resources and Conservation
32 South Ewing
Natural Resources Building
Helena, Montana 59601

By:

National Biocentric, Inc.
2233 Hamline Avenue North
St. Paul, Minnesota 55113

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INTRODUCTION

INTRODUCTION

This proposal is submitted in response to a Request from the Montana Department of Natural Resources and Conservation transmitted July 2, 1976. This Request for Proposal, outlines the Department's need for environmental data at the site of a proposed coal conversion facility in McCone County, Montana. This proposal presents the services, and technical capabilities of National Biocentric, Inc., and the costs of conducting the program outlined in the RFP. Since the RFP provided an excellent and specific outline of the technical aspects of the baseline survey we have not modified the technical program. However, for the purpose of clarity in our proposal we have included much of the material from the RFP as part of the proposal.

National Biocentric, Inc., is pleased to present this proposal to the Montana Department of Natural Resources and Conservation. National Biocentric, Inc., is an environmental planning and engineering firm with offices in St. Paul, Minnesota and Bismarck, North Dakota. Our experienced staff of over 30 people, offers clients a wide variety of disciplines which include biology, chemistry, engineering, geology, geography, planning, economics, sociology, statistics, and landscape architecture. Our staff and experience in environmental baseline studies make us ideally suited for the conduct of this study.

BACKGROUND

BACKGROUND

The Department of Natural Resources and Conservation is presently studying a coal processing facility in McCone County, Montana. The facility is a proposal of Dreyer Brothers, Inc., a wholly-owned subsidiary of Burlington Northern, Inc., and involves the conversion of lignite into one or more of the following products:

1. ammonia,
2. methanol-methyl fuel, and
3. diesel fuel.

At this time, Dreyer Brothers, Inc. has not applied to this Department for a Certificate under the Major Facility Siting Act. However, in accordance with the Act, it has chosen to initiate portions of studies which are ultimately required by law if the project proceeds. Since the company has not finalized its plans for the facility, the Department has determined that a baseline study is the extent to which the evaluation can be made at this time. In the event that Dreyer Brothers decides to proceed with the proposal, the baseline studies will be phased into the complete evaluation required by the Major Facility Siting Act, the Montana Environmental Policy Act and other applicable statutes.

TECHNICAL APPROACH

TECHNICAL APPROACH

I. STUDY OBJECTIVES

The baseline vegetation study aims at providing information that will be useful regardless of the final plant design. The proposal centers on a reconnaissance and classification of vegetation, and a vegetation map. This information is fundamental to impact prediction and the monitoring of any of the processes being considered by Dreyer Brothers, Inc. This study proposal will provide preliminary conclusions on environmental suitability and, in conjunction with baseline engineering and meteorological findings, guide the design of vegetation studies which will be conducted after Dreyer Brothers has made application under the Major Facility Siting Act.

The specific objectives of the vegetation baseline study are to:

1. Determine and characterize the major plant communities of the study area.
2. Determine and characterize habitat types, if possible.
3. Correlate communities to habitat types (or key site factors); at best, identify the association and series for each habitat type.
4. After analyzing the data and identifying communities and associated site factors, map habitat types and/or community types. (The results of the reconnaissance

must be known before determining whether both can be mapped for the total study area. Communities will be mapped for the mine area, plant site, and transportation corridors as specified by reclamation guidelines.)

-
5. Locate typical sites for later benchmark quantitative assessment, or other appropriate study. For example, typical sites (Daubenmires's definition in Science, 1966) should be identified during the reconnaissance. The vegetation map will indicate the major plant communities. Together, appropriate sites for benchmark study would be identified.
 6. Provide necessary data on range condition, trend, and productivity within the intensively studied area for purposes of ultimate reclamation analyses.

The design of the proposed vegetation baseline study will also:

1. Allow comparison of the plant communities of the study area with plant communities elsewhere where community response to stress from coal conversion facilities are being assessed. Ultimate impact prediction would then rely on community similarity, and engineering and meteorological data for the Circle West evaluation.
2. Provide data for use to other disciplines (e.g., soils, wildlife).

Later vegetation studies, referred to here as "benchmark," will focus upon such community attributes as productivity, species diversity, normal chemical composition of plants, and more precise data (on plant communities) amenable to statistical evaluation. Although the design of these studies enables them to begin at this time, it would not be possible to establish the basis for plot location or which species would be most closely examined. However, results of the vegetation study proposed here, as well as those from the meteorology and engineering evaluations, would provide a firm basis for developing the full study design. It is therefore proposed that the benchmark studies noted above not be initiated until the 1977 field season.

II. STUDY AREA

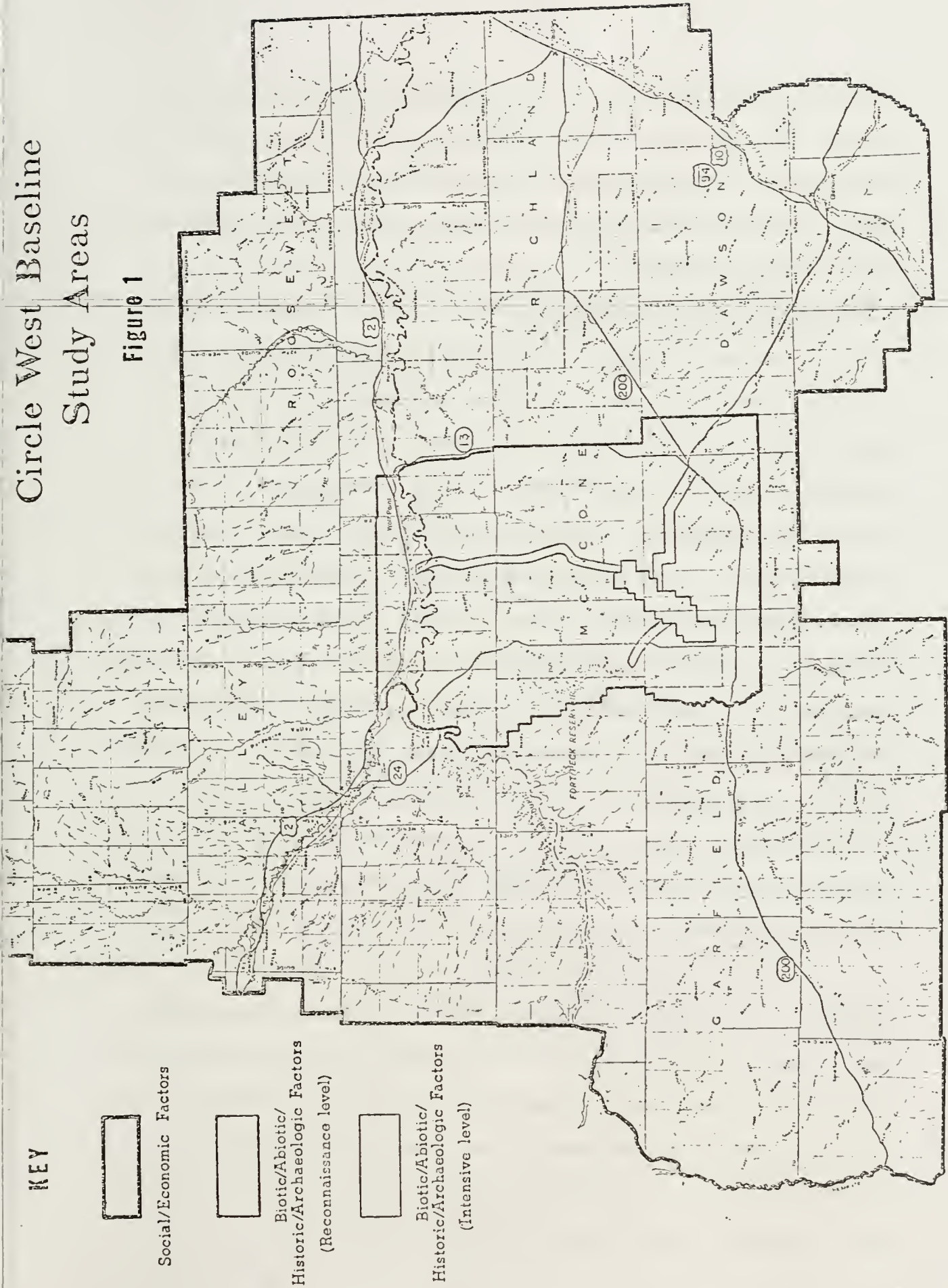
Two areas are identified for vegetation baseline study (see map).

1. Intensive study area. This area will comprise the mine, plant site, and possible transportation corridors where substantial earth-moving is required. Approximately 50% of the field work will center on this area. In addition to normal reconnaissance data (see III,B.), data required under the Vegetation Guidelines for the Strip Mining and Reclamation Act and Strip Mine Siting Act will be collected in a manner suitable to the Department of State Lands.

2. Reconnaissance area. This area was selected to cover the area most likely to be affected by airborne effluents,

Circle West Baseline Study Areas

Figure 1



whether from an on-site stream generator, the gasifier, or both. This area was also selected to include all major plant communities in the area, so that any later change in study area boundary would not make the baseline results inapplicable.

III. SCOPE OF WORK

A. Search for Extant Data

Some sources of existing data on vegetation for the study areas are the SCS, BLM, and State universities. SCS soil maps, range site maps, and precipitation maps should be reviewed, and the climax vegetation map of Ross and Hunter (SCS) should be considered. The BLM has been doing some vegetation mapping using color infrared signatures. MSU has identified some vegetative rangeland types for the area. Mel Morris (University of Montana) has done vegetation/soil relationship work nearby, and this might find application in the study. In short, a review of vegetation investigations in the area will be undertaken.

As usual, some reading of synecological texts and a review of autecological knowledge of the flora of the study areas should accompany the study.

In order to assure a proper focus for the benchmark/impact studies, a literature review should also cover the impact upon vegetation from pollutants known to originate from the Circle West Facility. This should range from studies of impacts to rangeland vegetation from power generators (e.g., Colstrip) to the physiological damage to plants from particular effluents, once these have been identified.

B. Field Survey Procedures

Existing data on vegetation for the study area will be useful, but is not expected to be of sufficient accuracy for impact prediction, identification of typical sites, etc. The following reconnaissance method is proposed to meet the objectives (Sec. I). A brief explanation of the use of the data follows the proposed reconnaissance technique.

1. Sampling Technique

Stands to be sampled will be identified on the basis of vegetational discontinuities which are visible by air photo and/or in the field. Data from one plot will be recorded for each stand sampled. A .008-acre plot (12.5' x 27.5') laid out along contours to minimize soil differences will be sampled. The plot location will be subjectively chosen to represent the stand, and for relative homogeneity. Ecotones will be avoided, and thus sampling will be non-random.

2. Proposed Vegetation Data Sheet (Tentative)

Location	Plot No.	Photo No.
General Vegetative Description	Aspect of Vegetation Dominants Grazing Pressure Picture No. (oblique color print)	
Site Description	Slope Aspect (in deg.) Slope (in deg.) Slope position (e.g., midslope, ridgetop) Elevation Horizontal configuration (e.g., convex) Distance to livestock water source Soil or soil texture (to be completed later) Precipitation	

Location	Plot No.	Photo No.
Other Observations		
Quantitative Vegetation	Spp. life form	Cover class
	life form, etc.	
	bare ground	
	rock	
	litter	
	lichens (non-epiphytic)	
	mosses	

Coverage will be measured by canopy coverage (polygon method) using the following classes:

T = <1%	4 = 50-75%
1 = 1-5%	5 = 75-95%
2 = 5-25%	6 = 95-100%
3 = 25-50%	

Life forms will be the following Raunkaier life forms: therophytes, geophytes, hemicryptophytes, chamaephytes, phanerophytes, epiphytes.

Late successional stands will be sampled in proportions greater than their abundance in the area might indicate, but all major communities will be sampled regardless of successional status.

This data will allow community type identification through ordination (using physiognomy, dominants, or floristic composition), as well as ordination of abiotic factors, and correlation of stand clusters to site factors. This data will also allow comparison with vegetation elsewhere, if it has been quantitatively described using coverage. Certain factors (e.g., soils) or species can be weighed, if desired, to

reflect the importance accorded to site components and plant indicators.

Range trend and condition will be determined, and productivity measurements made in the area to be intensively studied.

IV. TECHNICAL SPECIFICATIONS

In conjunction with the Department staff, National Biocentric, Inc., will collect vegetational data as presented in the above plan. Specifically this shall entail:

1. Collecting the requisite information within the reconnaissance level study area (See accompanying map). This shall not include areas lying within the intensive level study area.
2. Establish 200 or 250, .008-acre plots and collect vegetational data in accordance with the plan of study. (Responses to this RFP should reflect the two plot numbers). The department will specify the location of one-half of the plots; the remainder shall be determined by National Biocentric, Inc. When access to specified plots is denied, substitutions will be allowed.
3. Data to be taken at each plot shall be recorded upon forms provided by the Department. Such data shall consist of the following items, as indexed to the accompanying field data sheet:
 - a. Location: Location shall be noted on the form by township, range, and quarter-section (e.g.

FIELD DATA SHEET

(a) Location: _____ (b) Plot No.: _____ (c) Air Photo No.: _____
(d) Aspect of Vegetation: _____ (e) Dominants: _____
(f) Grazing Pressure: _____ (g) Picture No.: _____
(h) Observations: _____
Slope Aspect: _____ Slope: _____ Slope Position: _____
Elevation: _____ Horizontal Configuration: _____ Distance to Livestock _____
(j) Soil Texture: _____ (k) Soil: _____ (l) Precipitation: _____
Water Source: _____

Life-Form	Species	Cover Class	Life-Form	Species	Cover Class
			Mosses		
			(m) Lichens		
			Litter		
			Bare Soil		
			Bare Rock		

T. 20N, R. 45E., S.E. 1/4 of Sec. 12). Location shall also be marked on mylar overlays to air photos and 1/2 inch:1 mile maps.

- b. Plot numbers: Beginning at 500 and numbering consecutively.
- c. Air photo numbers: The index number upon air photos which will be provided by the department.
- d. Aspect of vegetation: This refers to the general appearance of the vegetation (e.g., midgrass prairie).
- e. Dominants: Those plants with the highest coverage.
- f. Grazing pressure: This is inferred, using knowledge of the effects of grazing and field comparisons.
- g. Picture number: A color slide shall be taken of each plot, showing the plot boundaries and indicating plot number.
- h. Observations: Any special comments. In addition, note whether a typical site is indicated.
- i. Distance to livestock water source: This information can come from air photos. If barriers prevent livestock from using the nearest water, enter distance to available water.
- j. Soil texture: Soil from each plot will be sampled and collected. Three samples of the upper

4 inches of soil will be collected using a 1.5 inch diameter tube blocked off 4 inches from the end. These samples will be kept in paper bags with the plot number recorded on the bag. These samples will be turned into the department for later analysis.

k, l. These will be left blank and filled in later by the Department.

m. Lichens: This refers to non-epiphytic lichens. Mosses and lichens shall also be collected (See 4, below).

COSTS AND SCHEDULE

COSTS AND SCHEDULE

1. Coordination with Department staff to determine study plots and to standardize field techniques.

	<u>Manhours</u>	<u>Cost</u>
Senior Scientist	24 hrs. @ \$26.00	\$ 624.00
Scientist	48 hrs. @ \$17.00	816.00
Consultant	24 hrs. @ \$13.00	<u>312.00</u>
	Subtotal	\$ 1,752.00

Tentative date July 21 through July 23

2. Collection of data in reconnaissance level study area, requiring .4 man-days per study plot (2 men sampling 5 plots per day).

For 200 plots

	<u>Manhours</u>	<u>Cost</u>
Senior Scientist	160 hrs. @ \$26.00	\$ 4,160.00
Scientist	320 hrs. @ \$17.00	5,440.00
Consultant	160 hrs. @ \$13.00	<u>2,080.00</u>
	Subtotal	\$ 11,680.00

For 250 plots

	<u>Manhours</u>	<u>Cost</u>
Senior Scientist	200 hrs. @ \$26.00	\$ 5,200.00
Scientist	400 hrs. @ \$17.00	6,800.00
Consultant	200 hrs. @ \$13.00	<u>2,600.00</u>
	Subtotal	\$ 14,600.00

Tentative dates June 26 through June 30
August 2 through August 6
August 9 through August 13
August 16 through August 20

3. Reduction of field notes, organization and coorelation of data.

	<u>Manhours</u>	<u>Cost</u>
Senior Scientist	40 hours @ \$26.00	\$ 1,040.00
Scientist	80 hours @ \$17.00	1,360.00
Consultant	40 hours @ \$13.00	<u>520.00</u>
	Subtotal	\$ 2,920.00

Tentative date August 23 through August 27

4. Data review, community identification and map preparation
(not including final graphic preparation and printing).

	<u>Manhours</u>	<u>Cost</u>
Senior Scientist	40 hours @ \$26.00	\$ 1,040.00
Scientist	80 hours @ \$17.00	1,360.00
Consultant	40 hours @ \$13.00	<u>520.00</u>
	Subtotal	\$ 2,920.00

5. Transportation

a. 4-wheel drive vehicle @ \$25.00 per day and \$.25 per mile (approximately 4,000 miles and 25 days)	\$ 1,625.00
b. 10 round trip flights from Minneapolis to Billings @ \$158.00 per flight	<u>1,580.00</u>
	Subtotal
	\$ 3,205.00

- | | |
|--|--------------------|
| 6. Lodging and food for 4 men, 25 days @ \$23.00 per day per man | <u>\$ 2,300.00</u> |
| | Subtotal |
| | \$ 2,300.00 |

- | | |
|---------------|--------------------|
| 7. Management | <u>\$ 2,480.00</u> |
| | Subtotal |
| | \$ 2,480.00 |

TOTAL COST 200 PLOTS	<u>\$ 27,257.00</u>
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TOTAL COST 250 PLOTS	<u>\$ 30,177.00</u>
----------------------	---------------------

SCHEDULE

July														August							Sept.												
<u>21</u>	<u>22</u>	<u>23</u>	<u>24</u>	<u>26</u>	<u>27</u>	<u>28</u>	<u>29</u>	<u>30</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>	<u>9</u>	<u>10</u>	<u>11</u>	<u>12</u>	<u>13</u>	<u>16</u>	<u>17</u>	<u>18</u>	<u>19</u>	<u>20</u>	<u>23</u>	<u>24</u>	<u>25</u>	<u>26</u>	<u>27</u>	<u>30</u>	<u>31</u>	<u>1</u>	<u>2</u>	<u>3</u>

Establish Plots <----->

Collect Data <----->

Data Collection <----->

Data Review
(Stand Ordination) <----->

CAPABILITIES

CAPABILITIES

National Biocentric, Inc., has a broad range of capabilities and experience in the environmental planning and environmental impact assessment programs. The firm was incorporated in 1971 as a successor to a proprietorship with consulting experience dating from 1966. Our staff is supplemented by affiliation with other consulting firms and independent consultants.

National Biocentric, Inc., has its main offices and laboratory located in St. Paul, Minnesota. Our laboratories are fully equipped to perform the many social, engineering, biological, chemical and ecological analyses that are relevant to assessment of man's impact on his natural and cultural environment. We routinely plan and conduct field and laboratory analyses of environmental quality parameters.

Joint Ventures and Participation in Professional Service Teams

National Biocentric, Inc., staff members have worked on projects which involved both teams of consultants and subcontractors. These included environmental assessments for the Corps of Engineers maintenance activities on 23 harbors in Lake Superior, the site development and long range planning for a Minnesota Mining and Manufacturing research and executive office complex in the Twin Cities area, assisting the North Dakota Public Service Commission with a Bismarck consultant in the development of criteria for large energy conversion and transmission facilities with the State of

North Dakota, and the environmental impact statement for a 1600 megawatt power plant in southern Minnesota. National Biocentric has been involved in numerous environmental assessments for the Metropolitan Waste Control Commission in the Twin City metropolitan area. These projects required direct coordination with various consulting engineers, the Metropolitan Waste Control Commission, and various state agencies. As a result of projects such as these, National Biocentric staff have gained considerable experience in working as a team member and managing projects which require significant team effort.

Project Specific Capabilities

National Biocentric, Inc., has conducted a number of ecological surveys. The following pages contain a partial listing of related environmental programs conducted by our staff. Our experience in ecological survey ranges from qualitative characterization of the natural environmental to quantitative analysis using such methods as aerial photo interpretation, "Importance Value" determination and based area analysis. The experience of our terrestrial biologists in plant taxonomy and community identification, combined with our statistics capability, make us ideally suited for the conduct of this environmental baseline study.

As pointed out in Daubenmire's "Vegetation: Identification of Typal Communities" (Science, January 21, 1966), the gradient analysis approach selected by the Department appears

well suited for studying the largely disturbed vegetation types found in the reconnaissance area. Also the relatively uniform substrates lend itself well to this approach. Several ordination techniques i.e. the statistical ordering of species populations and communities along the gradient will be considered including:

1. Index of Dominance, Simpson, E.H. 1949
2. Index of Similarity/Dissimilarity, Sorenson, T. 1942
3. Evenness Index, Pielou, E.C., 1966
4. Shannon Index of General Diversity, Shannon, C.E. and Weaver, W., 1949

The population distribution of species will then be plotted on a graph along with the gradient (range of environmental factors) and the relationships of the component populations within a continuum will be seen.

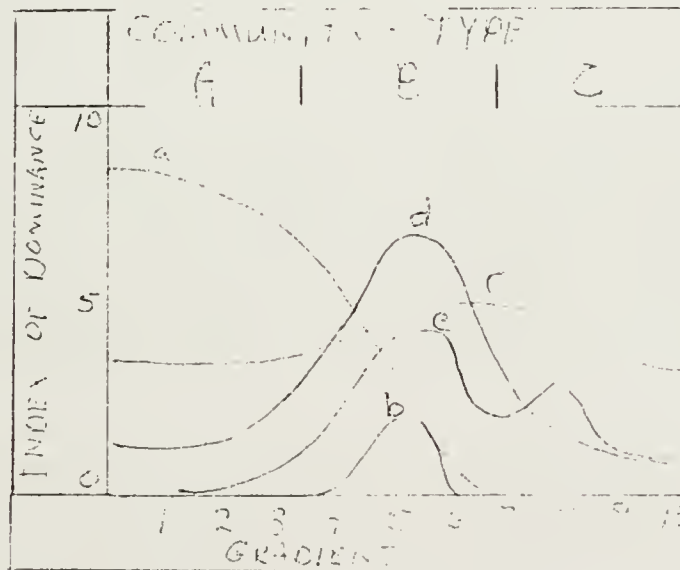
The figure shows the distribution of species along a hypothetical gradient of 1 to 10. Index of dominance is used to show stand ordination. As shown in this hypothetical model each species has a peak relative abundance at a different point along the gradient. The way in which the proposed mining activity will affect the gradient at the point of peak abundance and the importance of that specie can then be analyzed so a predicted impact on that specie can be made. For example if gradients 1, 2, 3, and 4 were altered by the mining activities to 5, 6, 7, and 8, specie a would be adversely impacted. Similar conclusions can be drawn about communities and population



diversity of the communities. The model also shows the tolerance of species to environmental changes. Species "b" is capable of limited growth under specific conditions. Species "c" is capable of substantial growth under a variety of conditions and so forth.

Special attention will be given to rare or endangered species on communities observed.

When the data collected in the reconnaissance level study area has been reduced and stand ordination and gradient analysis completed, predictions of the impacts of a coal conversion facility on the terrestrial environment can be made.



HYPOTHETICAL GRADIENT
ANALYSIS MODEL

RELATED PROJECTS



NATIONAL BIOCENTRIC, INC.

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2233 HAMLINE AVENUE NORTH
SAINT PAUL, MINNESOTA 55113

Project Title: Environmental Impact Assessment of Harbor
Operation and Maintenance Dredging Programs, on Lake
Superior and Lake of the Woods

Sponsor: U.S. Army Corps of Engineers
St. Paul District
St. Paul, Minnesota

Project Description: The Corps of Engineers is responsible for developing and maintaining 23 harbors in Lake Superior and Lake of the Woods. Development and maintenance of these harbors involves a significant amount of dredging. Historically, dredged spoil has been used for water front development, jetties and breakwaters with the majority dumped in open water.

The Environmental Impact Assessment program was conducted under a 15-month contract by National Biocentric, Inc. National Biocentric staff conducted extensive field research on both the natural and cultural environment.

The environmental assessments involved close cooperation between NBI staff members and representatives of the U.S. Army Corps of Engineers, the Federal Environmental Protection Agency, the Federal Bureau of Sport Fisheries and Wildlife, the Minnesota, Wisconsin and Michigan Departments of Natural Resources, local representatives, and university research personnel from the University of Minnesota, Duluth, the University of Wisconsin, Superior, and Michigan Technological University at Houghton.

The assessment included both the evaluation of existing knowledge as well as obtaining new data to conduct a truly interdisciplinary assessment of the operations and maintenance activities including dredging. Physical, chemical, limnological, ecological, and socio-economic assessments were made to determine the human impact of the proposed project. The impacted environment was defined in both terms of the micro and macro ecosystems.

Existing O & M projects and proposed confined dredge spoil disposal projects were assessed in terms of their impact on aquatic and terrestrial life systems including the social and economic systems and aesthetic values of man. Land use planning concepts were utilized in determining the best possible present and future use of shore land areas affected by dredge spoil disposal and associated creation of new land areas within harbors.



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Project Title: Rules and Regulations to Promulgate North
Dakota's Energy Facility Siting Legislation

Sponsor: Technical Planning Information, Inc., and
Public Service Commission, North Dakota

Project Description: The North Dakota Legislature recently enacted legislation governing the siting of energy conversion and transmission facilities in North Dakota. This legislation covered four types of facilities. A) Electric generating power plant, B) Coal gasification plant, C) Oil, water and natural gas pipeline, D) Electric transmission corridors. The Public Service Commission was given the responsibility for implementing this legislation. The Public Service Commission in turn contracted with TPI and NBI to develop the technical content and actually write the rules and regulations for the implementation of the statute.

In order to develop the technical content for the rules and regulations, an extensive literature search was necessary to determine what information existed on siting energy conversion facilities. This literature search was conducted specifically in North Dakota, but also in other states across the nation. In North Dakota, contact was made with approximately 20 agencies both state and federal which deal with topics covered by the legislation. On a nationwide basis, contact was made with the specific agencies of all 50 states (governor's office or environmental agency) in order to determine what had been done regarding energy facility siting. This contact with other states provided a historical background of energy facility siting as well as pointing out positive directions to proceed and also highlighting pitfalls which should be avoided in adopting rules and regulations.

The technical information gathered during the information gathering phase of this project will be condensed and written into a format of rules and regulations to promulgate the energy facility siting act. These rules and regulations will be written in a format consistent with that of the other state agencies in North Dakota. The final rules and regulations will go through an extensive review process involving a citizens advisory committee as well as a public hearing process throughout the entire state.



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Project Title: Comprehensive Long-Range Development Plan
for a New Corporate Research and Development Center

Sponsor: 3M Company
St. Paul, Minnesota

Project Description: The 3M Company is undergoing a rapid rate of corporate growth and expansion. Its existing corporate headquarters and research and development center will soon reach a design capacity of 16,000 employees. Additional expansion space is necessary and viewed to be desirable at a separate but nearby location.

Land for a new site encompassing 550 acres on the periphery of metropolitan development has been acquired.



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St. Paul, Minnesota

Project Description: The 3M Company is undergoing a rapid rate of corporate growth and expansion. Its existing corporate headquarters and research and development center will soon reach a design capacity of 16,000 employees. Additional expansion space is necessary and viewed to be desirable at a separate but nearby location.

Land for a new site encompassing 550 acres on the periphery of metropolitan development has been acquired. Based on present spatial design guidelines the new site could contain a substantial number of employees.

National Biocentric is working as one of the architectural and engineering team members responsible for the preparation of the comprehensive long-range development plans. National Biocentric has the responsibility for on-site and off-site community related environmental impacts. In this program the 3M Company has placed high emphasis on the environmental planning and engineering portions as an integral part of the first phases of concept design and long-range development planning. National Biocentric has the responsibility for contributing to the overall design and development concept as well as for clearly defining environmental constraints. An environmental impact statement will likely be required on this project.

In addition to the legal requirements for an environmental impact statement, this project will involve extensive planning and coordination with the many units and levels of government. The size and potential impact of the project requires that its planning and development be conducted in closest concert with the public agencies who in turn have the responsibility of planning and insuring the orderly and responsible development of their jurisdictions. The project is being approached as a model corporate development encompassing the corporate, governmental, the community and environmental interests.



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Project Title: 900 Megawatt Lignite Fired Electric Generating Plant

Sponsor: Basin Electric Power Cooperative
Bismarck, North Dakota

~~Project Description:~~ Basin Electric has proposed a 900 megawatt lignite fired electric generating plant near Beulah, North Dakota. The electric generating station is to be built on the same site as a coal gasification plant proposed by American Natural Resources Company. The coal gasification plant will require approximately one-half of the electricity generated by the power plant, the remaining electricity will be available to meet the needs of Basin Electric's service area.

Beulah is located in the center of the lignite producing areas of North Dakota. Within a 30 mile radius there are two existing lignite fueled electric generating stations, two electrical generating stations under construction and definite plans for one lignite fueled electric generating station, and a coal gasification plant. These projects will be completed or under construction before the Basin project is underway. In order to assess the impact of the proposed project on the environment, it is necessary to determine the impact of the existing, under construction and planned projects.

Basin Electric will prepare several environmental reports. National Biocentric, Inc. will conduct the research and prepare the cultural environmental assessment. The environmental documents will be prepared to meet the requirements of both the North Dakota Public Service Commission and the Rural Electrification Administration.

The cultural environmental assessment will be written as a planning document to be utilized by state agencies and local communities to deal with the impacts anticipated if the project goes ahead. In addition to the preparation of the cultural environmental assessment, National Biocentric, Inc. will prepare an impact alleviation manual for the local communities to assist them in scheduling and obtaining funds for community improvement projects to alleviate anticipated impact.



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2233 HAMLINE AVENUE NORTH
SAINT PAUL, MINNESOTA 55113

Project Title: Site Selection Study of a Sugar Beet
Processing Plant

Sponsor: The Northern Minnesota Sugar Beet Development
Association

Project Description: The project sponsor desired to construct a 6.5 ton/day \$75 million sugar beet processing plant in northwestern Minnesota. The Development Association selected four potential sites for the facility and engaged National Biocentric to develop the site selection criteria, test each site for criteria compliance and select the one site which exhibited maximum criteria compliance.

The study required a knowledge of all factors associated with sugar beet production, beet sugar processing, commodity (sugar, molasses, beet pulp) production and marketing. In addition the study required a knowledge of the beet supply area, transportation systems, water resources of the area, employment availability and waste management, as well as state and federal agency permit applications.

The site selection criteria consisted of 34 major parameters, each of which included several quantitative and/or qualitative sub-parameters relative to the physical, social and economic environment of the site and the surrounding area, as well as the construction and operational utility, transportation, employment and energy needs.

A weighting system was devised for each parameter and each parameter was ranked as to overall importance. Each site was then tested for optimum criteria compliance. The application of the weighting and ranking system permitted the objective selection of the most favorable site for the sugar beet processing plant. In addition it also indicated several less than optimum factors which could be enhanced once they were identified.



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2233 HAMLINE AVENUE NORTH
SAINT PAUL, MINNESOTA 55113

Project Title: Environmental Assessment, Woodlake Sanitary
Landfill

Sponsor: City of Medina

Project Description: Operators of the Woodlake Sanitary Landfill, located in the City of Medina in western Hennepin County, proposed to expand the existing facility from 28 to 68 acres.

National Biocentric, Inc., conducted a comprehensive analysis of the various aspects of the proposed expansion which could result in an impact on the environment. Those factors reviewed included the population and areas served, ultimate land use, topography, vegetation, and wildlife. Additional emphasis was placed on the hydrogeologic setting of the area and possible impacts on ground water. The generation and dispersion of methane gas was reviewed as to possible long-range effects on the surrounding area.

The environmental assessment was conducted to assist city and state decision makers in evaluating the site expansion proposal, while weighing the potential health risks against needs for solid waste disposal.



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2233 HAMLINE AVENUE NORTH
SAINT PAUL, MINNESOTA 55113

Project Title: Northern States Power Company Proposed
1700 Megawatt Generating Plant in Sibley County,
Minnesota: Environmental Impact Statement

Sponsor: Minnesota Pollution Control Agency
State of Minnesota

Project Description: The Minnesota Environmental Quality Council assigned the responsibility for the preparation of an environmental impact statement on the proposed Northern States Power Generating Facility to the Minnesota Pollution Control Agency. This assignment was one of the first major projects assigned by the Environmental Quality Council. The Minnesota Pollution Control Agency engaged National Biocentric, Inc. to coordinate and manage the preparation of an environmental impact statement on this facility, with inputs from a number of state agencies. National Biocentric, Inc. was chosen because of its extensive experience in managing interdisciplinary projects, as well as its extensive experience in the preparation of environmental impact statements on projects relating to the federal environmental requirements.

Major concerns on the part of state and other agencies with regard to the generating facility relate to air quality, water use, land use, and the impact on the social and cultural characteristics of surrounding communities.

The proposed plant site area is currently characterized by extensive agricultural activities. A total of approximately 3,300 acres is required for site development and boundary area.

The other major factors for consideration included the water requirements to be taken from the Minnesota River, the air shed for particulate and gaseous emissions, potential impacts on communities or agricultural activities, changing power demand projections, changing industrial and population growth projections, and fuel supply.

Throughout this program, close coordination was maintained with all of the state and federal agencies to insure the participation and contributions of experts representing the various contributory disciplines.



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2233 HAMLINE AVENUE NORTH
SAINT PAUL, MINNESOTA 55113

Project Title: Environmental Report - Power Plant Siting

Sponsor: Power Plant Siting Staff
Minnesota Environmental Quality Council

Project Description: Northern States Power Company proposes to construct a 1600 Megawatt fossil fuel steam electric generating station. Their application to the Minnesota Environmental Quality Council for a Certificate of Site Compatibility contained two candidate sites, one in Sibley County and one in Sherburne County, Minnesota.

National Biocentric, Inc. was contracted to conduct an environmental analysis of the sites contained in the application, and to provide support to the Council, its Advisory Committee, and Hearing Officer as they reached a decision on the siting question.

The environmental report prepared by National Biocentric, Inc., identified and analyzed the site differentiating characteristics. The analysis of the natural environmental factors revealed that while the proposed plant could be built at either site, the Sibley County site would require that 3,480 acres of prime agricultural land would be removed from production and used for industrial purposes, while at the Sherburne County site only 320 acres of agricultural land would be removed from production. The analysis of the cultural environmental factors revealed that while the proposed plant could be built at either site, the Sibley County site would require the displacement of 61 persons or 13% of the township population, while at the Sherburne County site no population displacement would be required. The analysis further revealed that the culture and the life style of the community surrounding the Sherburne County site would be more compatible to a power plant development than the community surrounding the Sibley County site.



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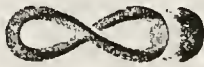
2233 HAMLINE AVENUE NORTH
SAINT PAUL, MINNESOTA 55113

Project Title: Environmental Impact Analysis for Water
Supply, Roosevelt, Utah and Uintah and Ouray Indian
Reservation

Sponsor: Economic Development Administration
Rocky Mountain Regional Office
Denver, Colorado

Project Description: The community and surrounding area of Roosevelt, Utah is an energy impacted area. The population of Roosevelt increased from 3,000 in 1970 to approximately 7,000 in 1975. The existing culinary water supply is of inadequate volume to accommodate the population increase and economic development. It is proposed that the existing culinary water supply for the community be augmented by capture of flow from Big Spring which is situated on Ute Tribal lands approximately 23 miles north of Roosevelt. The water from Big Springs is to be piped to Roosevelt and eventually to water districts located beyond Roosevelt. Grant applications have been made to the EDA for project funding and the EDA has requested that an Environmental Analysis be done on the project. National Biocentric, Inc., is presently preparing the Environmental Impact Statement on the project under NEPA guidelines.

The preparation of the statement has involved close co-operation between NBI staff members and EDA personnel as well as community leaders, regional and state agencies, University of Utah researchers, and Ute Tribal leaders. Major consideration in the study are economic development in the area, population projections, protection of the health, safety and welfare of the populace as it may be affected by an inadequate water supply, potential for induced development, availability of adequate development controls, and adequacy of community services to accommodate energy generated growth.



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2233 HAMLINE AVENUE NORTH
SAINT PAUL, MINNESOTA 55113

Project Title: Environmental Impact Assessment of Sludge Handling and Disposal, Metropolitan Wastewater Treatment Plant

Sponsor: Metropolitan Waste Control Commission of the Twin City Area, Minneapolis-St. Paul, Minnesota

Project Description: Handling and disposal of sludge resulting from municipal waste treatment is one of the most expensive and environmentally difficult aspects of wastewater treatment. As a result of new technology and the need for expansion, the Sewer Board was re-evaluating its sludge handling and disposal system.

The environmental impact assessment of the entire sludge handling and disposal system was a necessary part of the reevaluation.

The project included an assessment of the impacts generated by the thickening, conditioning, dewatering, incineration, pyrolosis, drying, product recovery, transportation, and ultimate disposal of the sludge. Environmental impact assessments such as this evaluate these impacts with respect to the natural and socio-economic environment and suggest measures to alleviate adverse impacts.

Of particular interest in this project was the beneficial and detrimental impacts generated by alternate fuel sources for pyrolosis of sludge. With potential limitations on supply of natural gas, consideration was given to utilizing municipal solid waste as a fuel source. Assuring a constant fuel supply and jurisdictional interests of various government agencies was a particular concern. Beneficial economic aspects of solid waste and sludge disposal combined with favorable environmental and land use alternatives appear to be positive impacts.



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(612) 633-8997

2233 HAMLINE AVENUE NORTH
SAINT PAUL, MINNESOTA 55113

Project Title: Environmental Assessment of Sludge Handling and Disposal, Blue Lake Wastewater Treatment Plant

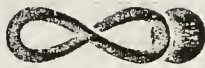
Sponsor: Metropolitan Waste Control Commission of the
Twin City Area, Minneapolis-St. Paul, Minnesota

Project Description: Treatment and final disposal of sludge resulting from operation of the Blue Lake Wastewater Treatment Plant which serves the southwest Metropolitan area. The Blue Lake Wastewater Treatment Plant was constructed to replace municipal treatment plants which were discharging effluent into Lake Minnetonka as well as several small lakes and streams in the area. In order to facilitate construction of the treatment plant, facilities for handling and disposal of sludge were not incorporated into the initial design. This environmental assessment dealt with methods for treating the sludge and alternatives for final disposal.

Two of the major considerations of this assessment were the alternatives available for final disposal and transportation mode to be utilized to convey sludge to the ultimate disposal site. Disposal methods considered were landfill, surface land spreading and subsurface land spreading. Railroad, barging, trucks and pipelines were evaluated as transport modes in terms of efficiency, reliability, flexibility and cost effectiveness.

Both the short and long range physical, economic and social impacts of the sludge handling and disposal methods were investigated. Of particular concern was the availability and use of technology for the recycling and recovery of resources in the form of nutrients for agricultural use and methane gas as a fuel for treatment plant operation.

The assessment provided input for the ultimate selection of the most economically feasible and environmentally sound method of sludge disposal and transport.



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2233 HAMLINE AVENUE NORTH
SAINT PAUL, MINNESOTA 55113

Project Title: Environmental Assessment of the Shoreview/
Little Canada Interceptor

Sponsor: Metropolitan Waste Control Commission of the
Twin City Area, Minneapolis-St. Paul, Minnesota

Project Description: An environmental assessment of a proposed interceptor to provide service to the communities of Shoreview and Little Canada to transport their wastewater ultimately to the Metropolitan Wastewater Treatment Facility in the Mississippi River at Pigs Eye. This project is intended to replace an interim facility which is at capacity and to alleviate malfunctions and service problems in the existing facilities. In addition, the interceptor will provide additional collection service to a portion of Little Canada which is not presently served by a sanitary sewer.

The assessment considered alternate routings of the interceptor in order to create the least environmental damage along the proposed route as a result of construction and to try to maximize collection service to the area. The major considerations involved in the assessment included the potential effects of construction of the interceptor on three lakes located in the area, the effects on a marsh area, and the effects of dewatering for constructing the deeper portions of the line on existing wells within the Shoreview/Little Canada area. Extensive additional subsurface work was conducted relative to the question of dewatering and its effect upon the existing wells. Since the interceptor is proposed principally to provide improved service along existing facilities, the socio-economic impacts of the project were not great. Detailed consideration of induced development and secondary impacts was not necessary in the completion of this project.



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Project Title: Environmental Assessment on the Proposed
Champlin/Anoka/Brooklyn Park Interceptor

Sponsor: Metropolitan Waste Control Commission of the
Twin City Area - Minneapolis-St. Paul

Project Description: An environmental assessment of proposed interceptor to provide wastewater collection service to the communities of Champlin, Anoka, Brooklyn Park and provide service to the peripheral communities of Andover, Dayton and Ramsey. The project involves the extension of wastewater collection facilities into areas not previously serviced by sanitary sewer.

The assessment considered alternate methods of transporting wastewater such as gravity, force main, or other combinations. The major issues involved in the environmental assessment were the routing of the interceptor to create the least amount of long-term environmental damage and the consideration of the impacts created by induced development through the extension of sewage collection facilities. In addition, consideration had to be given to the siting of a lift station and crossings of the Mississippi and Rum Rivers. The socio-economic considerations involved in the project were complicated by inter-community conflict over the project, population projections, and the question of induced development as a result of the collection facility extension.



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Project Title: Environmental Impact Assessment of the
Proposed Prior Lake Interceptor

Sponsor: Metropolitan Waste Control Commission of the
Twin City Area, Minneapolis-St. Paul, Minnesota

Project Description: An environmental impact assessment of a proposed sewage interceptor to be constructed from Prior Lake to the Blue Lake Regional Wastewater Treatment Plant. Presently the City of Prior Lake (Scott County, Minnesota) has a municipal wastewater treatment plant which discharges into the Credit River. This river does not have the capacity to assimilate extensive quantities of effluent from waste treatment plants. Many of the homes surrounding Prior Lake presently utilize on-site disposal systems which contribute to the degradation of water quality in Prior Lake. This project would eliminate effluent from the existing Prior Lake Treatment Plant to the Credit River, and would allow homes surrounding Prior Lake to be connected to municipal sewage systems.

Environmentally sensitive issues associated with this project are crossing a narrow portion of Prior Lake with the interceptor and disrupting vegetative and wildlife habitat along the corridor of the interceptor. The impact of this project on subsequent development in the area was also considered.



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Project Title: Environmental Assessment of the Beltline
Interceptor

Sponsor: Metropolitan Waste Control Commission of the
Twin City Area, Minneapolis-St. Paul, Minnesota

Project Description: An environmental assessment of proposed interceptor to transport wastewater from White Bear Lake to a major interceptor near Lake Phalen in St. Paul. This project would upgrade existing interceptor lines presently serving the community of White Bear Lake.

The assessment considered alternate methods of transporting wastewater such as gravity force main or other combinations utilizing existing facilities. The environmental assessment dealt with water quality issues and infiltration of storm water. The construction phase involved extensive disruption of the transportation system in the area and of recreational facilities. The proposed route was through many existing communities resulting in a complex socio-economic impact situation.



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Project Title: Copper-Nickel Mining in Northeast Minnesota:
Regional Baseline Environmental Monitoring System

Sponsor: State Planning Agency
State of Minnesota

Project Description: A number of companies currently have active copper-nickel exploration plans for Northeast Minnesota. The proposed copper-nickel mining region extends southward from the Minnesota-Canada boundary waters canoe and wilderness area, through regions of the Superior National Forest. The region is also on the eastern extremity of the Mesabi Iron Mining Range of Minnesota. As of this date, no definite plans for surface or underground mining, or for the type of ore concentration, or smelting have been laid.

Concern was raised by citizen groups, as well as state agencies, and the candidate mining firms, that comprehensive regional planning be a part of the proposed development plans for copper-nickel mining.

National Biocentric, Inc. under contract to the Minnesota State Planning Agency, prepared the baseline environmental monitoring program for this region of the state. The work included both surface and subsurface hydrology and water quality, the existing, or projected ambient air quality, vegetation and wildlife habitat, as well as other natural and physical environmental factors. The regional monitoring program had also placed great stress on defining the socioeconomic and cultural impacts of proposed mining activities. In this regard, a unique social values survey was designed. The social values survey is applicable not only in the copper-nickel mining regions, but is applicable also to any large state region which may, or may not, undergo external developmental pressures.

Development of the regional environmental monitoring program was done in concert with a number of state agencies, and this anticipated that it would be utilized by a number of state agencies, and private organizations as the design model for any subsequent monitoring programs.



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Project Title: Environmental Study of Pipeline/Dock
Expansion in Superior Harbor, Wisconsin.

Sponsor: Lakehead Pipeline, Inc.
Superior, Wisconsin

Project Description: Anticipated increases in shipment of petroleum products from Canada have generated the need for improved facilities to transship these products onto lake vessels. The anticipated increase in volume of shipments, combined with use of larger deep draft vessels requires improvements to the present dock. These improvements involve both structural changes and dredging to accommodate the deeper draft vessels.

National Biocentric developed a sampling plan and procedure for analysis of bottom sediments from the water/sediment interface to the depth of projected dredging. Profiles of the concentrations of toxic compounds, organic materials and oils were determined. These analyses were necessary to develop plans for construction as well as to apply for federal permits.



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Project Title: Environmental Inventory of Petroleum Pipeline

Sponsor: Lakehead Pipeline Company
Superior, Wisconsin

Project Description: Lakehead Pipeline Company operates a series of lines of differing dimensions and capacity routed through the states of Minnesota, Wisconsin and Michigan.

Field surveys, laboratory soil analysis as well as literature searches have been conducted in an effort to assess environmental damages from oil spills as well as to evaluate the effectiveness of reclamation measures in mitigating long-term adverse impacts.

The ultimate objective is to develop a manual of reclamation procedures which would effectively maximize environmental recovery from oil spill damages.



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SAINT PAUL, MINNESOTA 55113

Project Title: Environmental Inventory of Natural Gas
Pipeline Route

Sponsor: Great Lakes Gas Transmission Company
Detroit, Michigan

Project Description: The Great Lakes Gas Transmission Company maintains approximately 1,000 miles of natural gas pipeline through the states of Minnesota, Wisconsin and Michigan.

National Biocentric, Inc. was placed under contract by Great Lakes Gas Transmission Company to review the entire length of the pipeline in the United States. The purpose of the review was to evaluate the impact of previous activities and to prepare an inventory that would be of importance in the planning of additional looping or extensive capacity changes in the pipeline. The activities involved a series of aerial overflights with photographic documentation of specific environmental features of the route. On ground and on-site surveys were also conducted to characterize the various environmental regions of the line. The end product was a mile by mile inventory of the physical, natural, and sociocultural characterization of the entire 1,000 mile stretch.

Wherever environmentally sensitive areas were identified, specific and detailed analyses were conducted of these areas. Detailed descriptions and alternative operational options were presented. Specific attention was paid to river crossings, wetlands, or environmentally and geologically sensitive regions.



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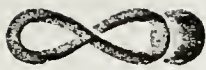
Project Title: Hydrology, Suspended Solids and Nutrient
Budget Analyses of a Complex Small Watershed

Sponsor: City of Albert Lea
Albert Lea, Minnesota

Project Description: The Albert Lea Lake watershed comprises a series of lakes ranging in size from a few acres to more than 2,500 acres. A number of the streams draining intensely utilized agricultural lands discharge into the lakes. A city with a population of 20,000 is located on the shores of the lake with direct storm sewer discharge. A number of industries including packing plants, processors of agricultural products, and foundries discharge cooling and processed waters into the lake. A municipal treatment plant for the city also discharges into the lake.

Long term discharge of both municipal and industrial wastes have been made into Albert Lea Lake. Albert Lea Lake was originally formed by impounding waters of the stream. The resulting lake is now enriched by both nutrients from the effluent discharge as well as resuspension of nutrients from the bottom and runoff from surrounding agricultural areas. The environmental assessment of a proposed expansion of municipal treatment plant facilities considered not only the impact of the treatment plant itself but also the continued availability of nutrients from alternative sources. The ammonia problems dealt with the toxicity of existing waters as well as the anticipated life supporting capacity of waters following the installation of the augmented municipal treatment facilities.

The watershed analyses program was conducted to determine the relative contributions of water, nutrients and suspended solids from several sources. The ultimate objective was to identify the most effective area for concentration in a watershed improvement program. The problems were large, and the available resources limited; thus, it was necessary to identify those sources that would be most responsive to treatment programs with limited expenditures.



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Project Title: Environmental Inventory, Tyler Creek
Watershed

Sponsor: U.S. Soil Conservation Service

Project Description: Tyler Creek Watershed encompasses 32,800 acres of primarily agricultural land in southwestern Minnesota.

National Biocentric, Inc., has conducted a comprehensive environmental inventory of the present conditions in the watershed. The items inventoried included the present status of land use, and ownership in the watershed as well as the land quality. Waterways were inventoried and described, and water quality samples were collected and analyzed. Ground water availability in the watershed was inventoried to determine its value as wildlife habitat. Data were obtained on wildlife abundance in the area. In addition, research based on secondary data was conducted to determine the social and cultural characteristics of the watershed.

The environmental impact analyses were conducted as part of an overall feasibility study by the SCS to determine the eligibility of the project for funding under public law 566.

RESUMES



NATIONAL BIOCENTRIC, INC.

(612) 633-8997

2233 HAMLINE AVENUE NORTH
SAINT PAUL, MINNESOTA 55113

Name: Arnold W. Blomquist

Education: Ph.D. 1963 University of Minnesota
M.S. 1961 University of Minnesota
B.S. 1958 Michigan State University

Position with National Biocentric, Inc.: President

Capability: Management and analytical technology, management of research and development programs, environmental impact assessments and market analysis.

Experience: 1963-1965--U.S. Air Force Eglin Air Force Base, Florida:

Project engineer on government research development and engineering programs. Contract research with universities, not-for-profit institutions and industrial firms.

1966-1970--Litton Industries, Inc., Applied Science Division:

Environmental Systems Director - responsibility for identifying fields for the transfer of sophisticated scientific and engineering capabilities toward promoting public health and welfare. Specifically identified needs for air and water pollution sampling instrumentation. The company developed instrumentation in response to these identified needs.

Director of Bioengineering Laboratory - Organized a bioengineering laboratory and managed federal government and corporate product development programs in health and environmental fields.

Director of Advanced Programs - Responsible for developing and implementing corporate plans for products and services in the environmental pollution control fields, management of government contract research relating to pollution control.

1971-Present--National Biocentric, Inc.:

Responsibilities included organization of the firm, management, sales, technical performance, recruiting, hiring, and supervising an interdisciplinary environmental staff. The firm was organized to provide services to government and industry in planning and evaluating policies, programs and specific

capital investment projects to insure that the projects represent the most environmentally sensitive and sound programs that are possible. The philosophy of the firm is to provide its clients with an interdisciplinary professional environmental capability that will insure that all aspects of the environment are considered in planning, evaluating, assessing or reviewing specific projects.

The firm is composed of environmental professionals representing an interdisciplinary capability. The staff have professional degrees in sociology, economics, urban planning, land use planning, geography, landscape architecture, biology, biochemistry, chemistry, limnology, agriculture, soils, geology, engineering, accounting, finance and law. The staff is organized in such a way that there is a ready and forced interchange of ideas between professionals with various academic backgrounds and experience.

The company also stresses the importance of the collection and interpretation of primary data relating to the planning, analysis, and environmental assessment processes. Toward this end, the company has sophisticated field and laboratory equipment suitable for most areas of chemistry, biology, ecology, etc. The laboratory and field staff are composed of professionals and technicians able to conduct studies involving air, surface and ground water, effluent discharge, soil contamination, vegetation, wildlife, etc.

The company also has the capability of both utilizing and building upon the existing base of socio-economics, demographic, cultural, anthropological and historical data. The firm has developed monitoring programs for assessing the impact of both large and small scale projects on the social, economic, and cultural environment of urban and rural areas. The firm has the capability of designing and conducting large scale demographic, socio-economic and attitudinal surveys of residents.

In support of the above areas, the firm has computer programming and analysis capability and routinely develops descriptive and predictive models in the physical, natural and social sciences.



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2233 HAMLINE AVENUE NORTH
SAINT PAUL, MINNESOTA 55113

Name: Roger V. Blomquist

Education: Ph.D. 1970 University of Wisconsin
B.S. 1966 Michigan State University

Position with National Biocentric, Inc.: Senior Vice President

Capability: Environmental impact analysis, program management, environmental planning, analytical technology, agriculture.

Experience: National Biocentric, Inc.: Senior Vice President responsible for management of environmental studies in the areas of urban, regional, open space, landscape architecture, land use and recreational planning. Manager of environmental impact studies. Coordination with federal, state, county, and local units of government as well as environmental groups. Corporate responsibilities include personnel development, marketing and sales.

National Biocentric, Inc.: Vice President, responsible for management of studies in the physical and natural environmental area. These studies involved the disciplines of geology, hydrology, geography, engineering, limnology, vegetation and wildlife management. Manager of environmental impact studies including the necessary coordination with various state and federal regulatory agencies as well as environmental groups. Conduct environmental impact surveys relating to engineering projects.

National Biocentric, Inc.: Laboratory Manager, responsible for environmental analysis and complete quality assurance involving chemical and microbial analysis of waste and final products for manufacturers.

University of Guelph: Post-Doctoral fellowship in chemical analysis of food products.

University of Wisconsin: Research assistant in biochemistry and agronomy involving microanalysis and development of laboratory methods for biochemical analysis.



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Name: Robert W. Arko

Education: M.S. Candidate Oklahoma State University
B.S. 1971 University of Minnesota

Position with National Biocentric, Inc.: Geological and Soils
Engineering

Capability: Geology and soils, environmental impact analysis
for industrial development, power plant siting,
engineering geology, pipelines, wastewater treat-
ment and support facilities.

Experience: National Biocentric, Inc.: Geology and soils
investigations; responsible for environmental
engineering and planning; field surveys, in-
ventories, contributions to computerized land
use planning. Environmental impact assessments,
design of site reclamation, activities in in-
dustrial development, mines, pipelines, high-
ways, and power plants.

Assistant Geologist at Dames & Moore, Consulting
Engineers. Performed field investigations for
nuclear power plants, railroad spurs, warehouses,
and the Trident nuclear submarine facility. Ex-
perience in soil and rock sampling and testing;
pressure testing procedures for determining rock
permeabilities; and piezometer installation pro-
cedures.

Consulting Engineers Diversified, Inc.: Junior
Equipment Operator. Operated soil sampling rigs,
logged samples in the field, tested samples in
the lab, conducted geologic research.

Minnesota Geological Survey: Technical Consul-
tant. Mapped the glacial and bedrock geology of
7 1/2 minute quadrangle in the St. Paul, Minnesota
area. Compiled engineering and hydrogeologic data
on the units defined on the map. Analyzed and
logged soil and rock cuttings from water wells.



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NATIONAL BIOCENTRIC, INC.

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SAINT PAUL, MINNESOTA 55113

Name: Mary M. Blomquist

Education: Ph.D. 1966 University of Minnesota
M.S. 1960 University of Minnesota
B.S. 1958 Iowa State University

Position with National Biocentric, Inc.: Senior Mathematical
Statistician

Capability: Development, evaluation and utilization of engineering and biological simulation models, development of statistical methods, data analysis, computer programming, cost-benefit analyses. Design and analysis of surveys and experiments for assessing impacts of proposed projects.

Experience: National Biocentric, Inc.: Design of models to predict physical, social, economic and land use impacts of proposed developmental projects. Design of experiments and surveys to provide input to impact models. Analysis of primary and secondary data relating to impact assessment. Cost/benefit analysis.

Research, optimization and analytical studies relative to performance benefits gained by various levels of technological innovation incorporated in engineering development projects.

Biocentric, Inc.: Senior Statistician responsible for design of engineering and socio-economic tests and surveys, data analysis, summarization and presentation of data. Consulting service to industry, universities and government agencies. Multivariate analysis of causal factors which serve as the basis for formation of public attitudes and perceived impacts of engineering projects.

USAF: Mathematician and Operations Analyst.

Mary M. Blomquist
Resume
Page Two

University of Minnesota: Research assistant in design and analysis of experiments, surveys, etc., computer analysis and development of analytical models in the physical and biological sciences.



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NATIONAL BIOCENTRIC, INC.

2233 HAMLINE AVENUE NORTH
SAINT PAUL, MINNESOTA 55113

Name: Leland F. Comb

Education: B.S. University of Minnesota

Position with National Biocentric, Inc.: Limnologist

Capability: Development and implementation of lake restoration programs. Limnological and water quality investigations of freshwater systems. Geographical, vegetational, and land usage analysis of watersheds. Aquatic biota studies.

Experience: National Biocentric, Inc.: Project director for limnological trophic nature data base determination and freshwater nutrient cycle programs. Lake analysis and rehabilitation program development. Natural water chemical analysis. Environmental impact assessment of municipal wastewater system construction.

Limnological Research Center, University of Minnesota, Minneapolis: Limnological data collection and chemical analysis of the Minneapolis City Lakes. Chemical analysis of lake sediment cores. Coordination of a public orientated limnological data collection program throughout the state of Minnesota. Limnological Research Center public relations.

Nason, Wehrman, Chapman Associates, Inc.: U.S. Corps of Engineers studies of environmental conditions covering wildlife, vegetational and water quality for the Redwood River, Marshall, Minnesota and the Marion County Drainage District, Marion County, Missouri.

University of Minnesota, Landscape Architecture: Recreational potential study of the then proposed St. Croix River National Scenic Riverway.

University of Minnesota, Geography: Data collection and coordination for the Minnesota state-wide computerized land-use classification inventory.

University of Minnesota, Biochemistry: Biochemical studies of pesticide degradation.

Member: American Society of Limnology and Oceanography.



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Name: C. A. (Michael) Helffrich

Education: B.S. 1965 Iowa State University
M.Th. 1969 Jointly: University of Chicago
Luther Seminary

Position with National Biocentric, Inc.: Plant Ecology and
Environmental
Systems

Capability: Design and implementation of vegetation monitoring systems, baseline succession and energetic studies, aerial photography, radar and scanner interpretation, qualitative site analysis, taxonomic enumeration, environmental impact assessments.

Experience: National Biocentric, Inc.: Environmental impact assessments with regard to vegetation, wildlife habitat, and ecosystem interaction. Design and implementation of environmental monitoring studies.

Land use planning (environmental aspects), environmental education, interpretive systems design, computer based monitoring studies and geomancy. Experience in all major North American climates and terrestrial vegetation communities.

Hennepin County Park Reserve District: Naturalist

North Star Research and Development: Research assistant in urban environmental problems.

Boundary Waters Canoe Area: Professional canoe guide, five years.

Chicago Public School System: Junior high school science teacher

Instructor: Medicinal uses of North American flora.

Instructor: Organic farmer and gardening.

Venezuelan Government: Vegetation researcher in the Orinoco River Watershed.



NATIONAL BIOCENTRIC, INC.

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2233 HAMLINE AVENUE NORTH
SAINT PAUL, MINNESOTA 55113

Name: Dan E. Huff

Education: Ph.D. Wildlife 1973 University of Minnesota
M.S. Wildlife 1970 University of Minnesota
B.S. Biology 1966 Lamar University, Texas

Position with National Biocentric, Inc.: Wildlife and
Animal Ecology

Capability: Animal ecology, wildlife populations, wildlife habitat, nutrient content of browse, interaction of man's activity on wildlife populations, environmental impact assessment.

Experience: National Biocentric, Inc.: Consultant in environmental impact assessments, with particular reference to wildlife, habitat, and ecosystems. Conducting survey studies to determine existing populations and projecting the impact of proposed developments on habitat and population dynamics.

Suburban Hennepin County Vocational Technical School: Instructor and Curriculum Writer.

University of Minnesota: Research Fellow.
"A Study of Selected Nutrients in Browse available to Ruffed Grouse," "Some effects of forest manipulations on Ruffed Grouse - Nutrient Relationships," "Wildlife - snowmobiling interactions project," "A Correlation of deer movement with snowmobiling activity," "Summer trends in leaf nutrient content of some common plants of the Itasca Region."



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Name: Robert J. Kadwell

Education: Ph.D. Candidate University of Minnesota
B.S. 1965 University of Missouri
Rolla, Missouri

Position with National Biocentric, Inc.: Vice President,
Natural and Physical
Sciences

Capability: Surface and ground water hydrology, geology,
watershed analysis, environmental impact analysis
for industrial developments, mining operations,
pipelines, engineering geology, and technical
monitoring.

Experience: National Biocentric, Inc.: Hydrologic analysis,
surface and subsurface hydrology, watershed
analysis, technical monitoring for mining opera-
tions. Environmental impact assessment for
industrial plants, power generating plants, min-
ing operations, pipelines, and waste treatment
facilities. Coordination with regulatory agencies
and environmental groups.

University of Minnesota: Teaching and research
relating to geology and water resources manage-
ment and field geology.

Research: Hydrologic study of buried bedrock
valleys, combining water chemistry, geophysics
and mathematical modeling. Hydrology of three
small watersheds.

Geotechnical Engineering Corporation: Hydrologic
field work, consulting hydrology, especially de-
watering, soil and foundation engineering, super-
vision of drilling crews for test borings.

U.S. Army: Soil technology and training soil
technicians in geology, soil testing and soil
analysis including both laboratory and field work.

Mobil Oil Company: Geophysical exploration for
oil, involved in the field gathering of seismic
data, interpretation of the results and geologic
mapping.



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Name: Rod Leas

Education: M.A. Candidate Mankato State University
B.S. 1969 University of Minnesota

Position with National Biocentric: Project Manager

Capability: Environmental Planning, Design, Inventory, and Assessment.

Experience: National Biocentric: Project manager and principal investigator of federal, state, local and industrial projects involving energy transmission, and land and water resources.

Developed geographic and systematic field data inventory and assessment procedures of physical, biological, and cultural systems likely to be impacted by construction or operation of proposed projects.

Project management experiences include assessments of oil and gas pipeline, steam-electric power plants, high voltage transmission lines, harbor operation and maintenance, and navigation dredging. Additional experience includes conduct of watershed characteristic inventories, and lake restoration programs.

U.S. Army Corps of Engineers: Branch Administrative Assistant, responsible for review and assessment of U.S.A.C.E. project related environmental assessments.

Minnesota State Planning Agency: Consultant, developed review and assessment procedures for projects funded by Bureau of Outdoor Recreation.

City of Mankato, Minnesota: Planner, developed urban and open space plan for regionally integrated multiple use trail system.

Mankato State University: Instructor, Department of Geography.



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Name: Arnett C. Mace, Jr.

Education: Ph.D. 1967 University of Arizona
M.S. 1962 University of Arizona
B.S.F. 1960 West Virginia University

Position with National Biocentric, Inc.: Forest Resource
Management

Capability: Watershed values, forest management, environmental quality, aerial photography, remote sensing techniques, water resources management, forest hydrology, ecosystem analysis of water quality and aquatic life.

Experience: University of Minnesota: Professor and Head, Department of Forest Resources. Research and education in forest hydrology programs. Provided instruction for the following courses: air and water quality, forest meteorology and hydrology, advanced forest hydrology, and field hydrology. Research included studies of effects of runoff, energy balance of peatland and forest vegetation, recreation and water quality relationships, nutrient cycling in forest ecosystems and hydrologic and economic relationship related to alternative forest management systems. Develop, coordinate and conduct forest hydrology research in the College of Forestry. Responsible for general management and administration of Forest Resources Department. The department has approximately 30 faculty members, 450 undergraduates and 65 graduate students.

University of Arizona: Instructor-Research Associate, Department of Watershed Management. Developed, coordinated and executed studies designed to quantitatively evaluate evapotranspiration rates of phreatophytes and replacement vegetation in relation to climatic, physiographic and hydrologic parameters. Responsible for development of types of procedures, instrumentation, data collection, analysis of data, and preparation of contract report for the U.S. B.R.

Arnett C. Mace, Jr.
Resume
Page Two

Rocky Mountain Forest & Range Experiment Station: Research Forester. Position involved professional work in watershed management research. Duties included preparation of study plans, and following approved study plans conducted investigations of the effects of forest and forest-range cover types and the use of these types on surface runoff, erosion, soil moisture, snow accumulation and melt, evapotranspiration, and total water yields. Made detailed measurements of sample areas, analyzed data, and reported results. Other duties consisted of conducting show-me trips of research being conducted by the station to various groups and presentations of results to numerous organizations involved in watershed management research administration.

University of Arizona, Department of Watershed Management: Graduate Research Assistant. Duties consisted of establishment, collection of data, and analysis of fertilization studies in the chaparral and ponderosa pine types. This position involved the proposal, planning, and completion of a study of, A Measure of the Effect of Soil and Atmospheric Moisture on the Growth of Ponderosa Pine.

Inter-
national

Experience: A Study of the Water Resource Systems of Morocco with Emphasis on the Interaction of Forests, Water and Agriculture - Office of International Programs, University of Minnesota - November 1971.



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Name: Paul A. Noreen

Education: M.S. 1968 University of Minnesota, College
of Forestry
B.S. 1966 University of Minnesota, College
of Forestry

Position with National Biocentric, Inc.: Forestry Consultant

Capability: Silviculture (ecological management of plant species), forest entomology and pathology, forest policy and administration, land economics, general ecology, tree and plant identification, forest recreation, range management, determination of timber values.

Experience: Established the forest consulting firm, Natural Resource Services, which provides professional forestry advice and service to legal firms, real estate firms, forest industry, investors, and a wide range of individual landowners.

Penta Wood Products - Siren, Wisconsin: Worked as industrial forester on raw materials procurement, management of raw material production, and management of company forest lands.

C.R.E.A., a regional development agency of Ecuador: Initiated and coordinated a program to test tree species from other regions of the world as to their potential growth and development in the Andes Mountains of southern Ecuador, advised extension agents and provided technical assistance to the forest nursery staffs.



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Name: Mark A. Norgaard

Education: B.A. 1973 Gustavus Adolphus College

Position with National Biocentric, Inc.: Terrestrial and
Aquatic Biologist

Capability: Assessment and impact analysis of the natural environment, field investigations, aerial photo interpretation, field surveying, watershed analysis, water quality analysis and nutrient budget assessment of fresh water systems.

Experience: National Biocentric, Inc.: Evaluation of the terrestrial and aquatic environments for projects requiring environmental assessment and impact analysis. Project manager of programs involving nutrient budget and water quality analysis, preparation of lake restoration grant applications, project manager of environmental assessment of a sewage sludge disposal program, environmental evaluation of power plant siting and energy transmission lines, topographic survey, laboratory analysis of water and wastewater, and nutritional labeling.

National Science Foundation: Collection and identification of aquatic insects under a NSF grant in entomological research involving the distribution, emergence and taxonomy of dragonflies in Minnesota.

Gustavus Adolphus College: Undergraduate assistant involved in developing an animal behavior research laboratory and ethology curriculum.

